Contents

Golden State
FLOODLIGHT

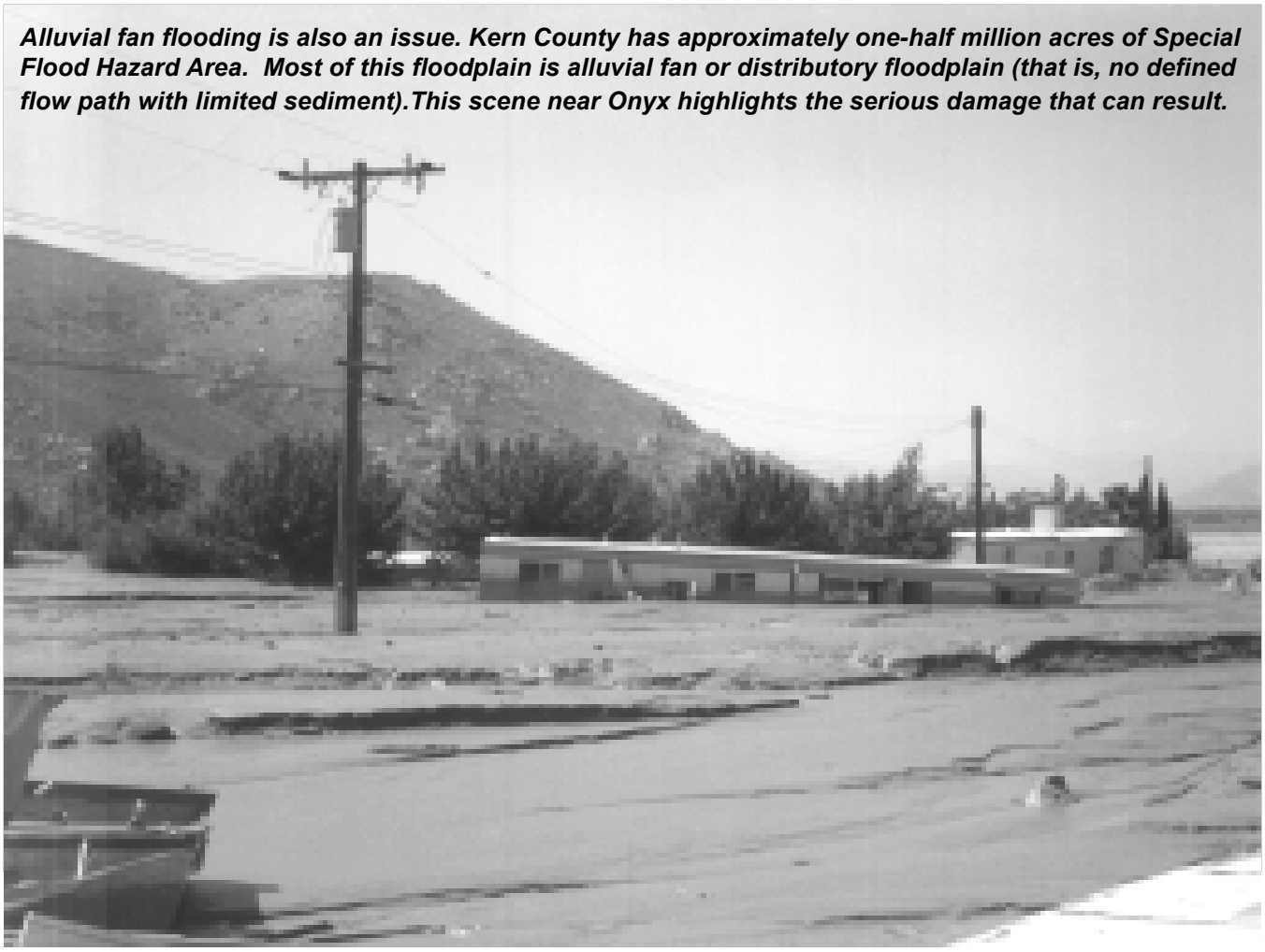
California Floodplain Management Newsletter
A publication of the Department of Water Resources
Volume 15, Issue 1, Spring 2002

Kern County *Floodplain Management* or "CAUGHT BETWEEN ..."

by Clark Farr, P.E.

The administration of Floodplain Management for the County of Kern has grown from just the National Flood Insurance Program's local ordinance enforcement responsibilities to include local preparation of flood inundation studies, analysis and development of stream flow hydrology, flood control master planning, preparation of grant applications, and even design and construction of flood control projects. However, *all* of these functions are performed from within the county's general function, without the establishment of a Flood Control District. As such, the role of Floodplain Management is subject to the availability of monies from Kern County's General Fund.

Kern County is California's third largest county in area: 8,100 square miles, with the greatest amount of privately owned land: 6,500 square miles. The county-wide population count is 630,000 - half of that population is located in the greater Bakersfield area. Another 100,000 reside in the other ten incorporated cities. This leaves 130,000 residents scattered through the unincorporated area. By comparison to the other counties, Kern is large geographically and by population, but when compared to the major population centers throughout the rest of the State, Kern is very rural and is considered a small



Alluvial fan flooding is also an issue. Kern County has approximately one-half million acres of Special Flood Hazard Area. Most of this floodplain is alluvial fan or distributory floodplain (that is, no defined flow path with limited sediment).This scene near Onyx highlights the serious damage that can result.

county. The county encompasses three major and diverse regions: *the lower San Joaquin Valley region*--Kern County covers the southern end of the valley; *the Tehachapi/ Piute Mountains region*--these mountains form on the western side of the Garloc Fault as it separates easterly from the San Andreas Fault; and *the Mojave Desert* region.

Kern County also contains approximately one-half million acres of *Special Flood Hazard Area*, of which less than 20% has been studied in detail. Most of this floodplain is alluvial fan or distributory floodplain (i.e., no defined flow path with limited sediment load).

Economically, Kern, as the largest oil producing county in the lower 48 states, has vast natural and agricultural resources. Its tax base is dependent upon resource development, not industrial or commercial revenue sources. This relatively constant revenue source makes Kern County the envy of other rural counties and is viewed as *self-sufficient* by more affluent counties and by the State. This revenue is both boon and bane. This wealth has allowed the county to take on programs that only wealthy communities can afford, such as a county hospital; an extensive county fire department--the CA State Department of Forestry and Fire Protection is tasked with providing fire protection for unincorporated county areas in the absence of a county fire department; and the maintenance of commercial highways--Caltrans has the task of maintaining truck routes in most other rural counties. On the other hand, these resources establish a false perception of wealth, both at a local voter level and at a state assistance level. Local voters are unwilling to tax them-

selves for needed infrastructure improvements (such as flood control). Local politicians have been able to establish a hard line against indebtedness--Kern County has a very low debt ratio--so programs and services live hand to mouth on a pay-as-you-go basis. State level assistance is not available because of the perception that a true economic need does not exist. The end result is that Kern County does not qualify for either aid for rural communities or for urban community assistance.

Geographically Kern County finds itself split between northern and southern California. The desert regions of California, including Kern County's portion of the Mojave Desert, are typically looked upon as "the south"; the San Joaquin Valley is typically considered part of "the north". Our agriculture is a large importer of Sacramento River water, and thus rural communities in "the north" look upon the county as "the south". The US Army Corps of Engineers, FEMA, CA DWR, and various other agencies, both federal and State, split the county between their northern and southern California regions.

All of the above sets the stage upon which Kern County Floodplain Management must function. The county must deal with development in areas for which only FEMA Zone "A" designations have been made, i.e. no detailed study. We, KCFPM, do this by establishing some simple assumptions, that is, assumed average velocity, assumed depth of flow, etc., by which each individual development must then prepare flood routing studies which are used to develop Base Flood Elevations and ensure that development encroachment does not exceed 1.0 feet above natural conditions. The county, from time to time, finds funding to prepare its own flood studies and has received assistance from the CA Department of Water Resources for additional studies. This, however, is a mainstream problem with which most communities must deal. It is in dealing with mitigation of existing flood-prone development that causes Kern County to be at odds with itself.

The county finds itself torn between the needs of a vibrant agricultural economy and the needs of residential users. Farmers have the ability to construct levees to protect their crops, thus diverting and channelizing floodwaters onto downstream properties, typically rural residential communities. This practice can be stopped, but the crops would be lost along with the jobs associated with the crops, such as harvesting and processing. The workers who have these jobs live in the homes impacted by the diverted and channelized floodwaters. Because there are no flood control monies available, Kern is left with only two options. Do nothing to stop the farmer levees and allow existing residential flooding problems to worsen, or intervene to stop the practice of farmer diversion levees and potentially eliminate hundreds of jobs and the livelihood of a community.

In summary, Kern County Floodplain Management is uniquely challenged by being both "north" and "south", "large" and "small", "rural" and "urban", self-sufficient and needy, protective of economic interests and residential interests, as well as all combinations and permutations of the above. ***Thus challenged, we persevere!***

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Note to CA* Community Floodplain Managers/ Administrators: You have just read Clark Farr's account of the current situation in Kern County -- let ***The Floodlight*** also present *your* story here. Submit draft article via e-mail to **jbrown@water.ca.gov** or by mail to A. Jean Brown, 1416 Ninth Street, Room 1623, Sacramento 95814.

*Will consider printing stories on this subject of strains and restraints affecting administration of community floodplains from other states, with special consideration given to our close neighbors, Arizona, Hawaii, and Nevada.

It's Best To Be ALERT!

by Rob Nelson

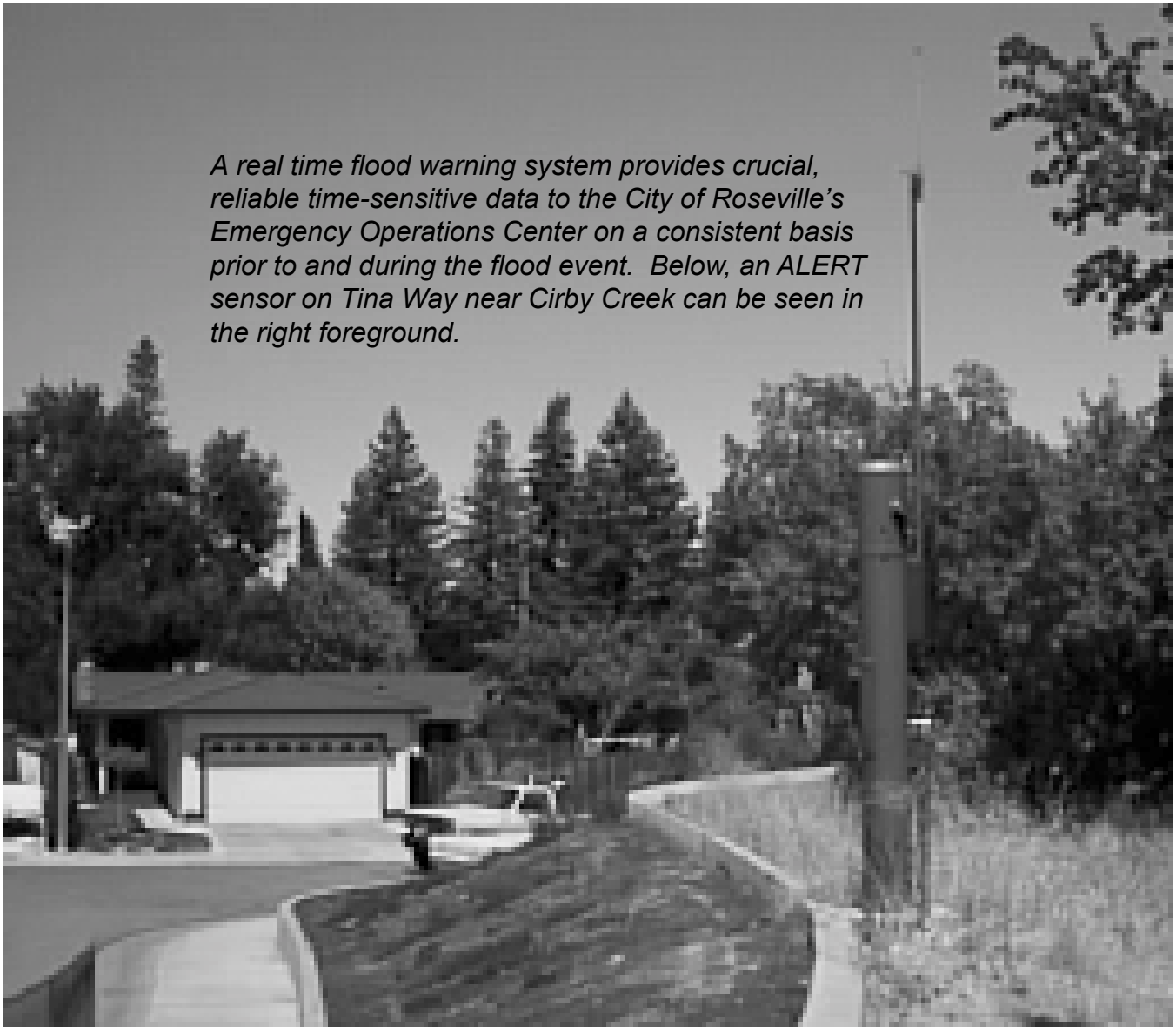
The duties of managing a floodplain are extensive. Assessing and solving floodplain issues involve highly technical problem solving along with adept public administration skills. Successful floodplain management involves integrating competing demands with public safety. The core focus is, ultimately, *public safety*. When watersheds spill over their banks and begin to threaten life and property, there is no longer any issue *except* public safety. It is crisis management where time and data are critical. The lack of either could result in dire consequences. A real time flood warning system can provide this critical time-sensitive data. This data needs to be reliable and available on a consistent basis prior to and during the flood event. Beyond the collection of data, the system must be able to deliver this data to the appropriate personnel in a concise and timely manner.

The system can also yield another benefit - by increasing public awareness of the threat of floods and improving public response to flood warnings. A typical response by the public during a crisis is to demand verification that a threat is present. Once the flood warning system is installed, the public should be made aware of its function and role [in providing this verification] before the flood. This will greatly enhance the effectiveness of your flood warning messages. These elements must be handled prior to a flood event - 90% of the work of successful management of a crisis is done before the event even begins.

The purpose of this article is to provide a brief synopsis of the principal components of implementing and maintaining a real time flood warning system. The type of system outlined herein is an ALERT system. ALERT is an acronym for Automated Local Evaluation in Real Time. This strategy was developed at the California-Nevada River Forecast Center in the early 1970's to empower local communities to monitor and forecast flood threats. It has become an important tool that, with the cooperation of the National Weather Service, has enabled many communities in California and the nation to minimize the dangers of flooding to life and property.

The basic design of an ALERT flood warning system is fairly simple. A number of automatic reporting gauges, measuring both rainfall and streamflow, transmit data to a central processing center or base station. Data from the gauges is processed by computer software at the base station. This software collects and summarizes the data giving the observer a real time overview of the flood threat. The automation and real time aspect of data collection and analysis are crucial to the ALERT warning system operation. To achieve that, ALERT systems initially used radio telemetry. This is still prevalent today, but with the enormous technological advances in communication, other methods such as satellite transmissions are now also being used. Research is also beginning on advancing the radio protocol to reflect those changes in the communication field.

Although the principle elements of an ALERT system are pretty much straight forward, the planning and implementation of the system should follow a carefully directed process. The most effective network of data collection on rainfall and stream flow can be rendered nearly worthless unless it is effectively woven into a community's flood response plan. The flood warning system should be a reflection of the flood response plan. All those individuals, including representatives from the public, who have a key role in the flood response plan should be included during the planning phase of the system. Once the warning obligations are derived from the flood response plan then the more technical aspects of location, number, and type of gauges can be considered.



A real time flood warning system provides crucial, reliable time-sensitive data to the City of Roseville's Emergency Operations Center on a consistent basis prior to and during the flood event. Below, an ALERT sensor on Tina Way near Cirby Creek can be seen in the right foreground.

The ALERT gauges themselves have been standardized to some extent by the National Weather Service. These standards were developed with a focus on reliable reporting and widespread distribution. Rainfall sensors are of the tipping bucket type. They are mounted in a 12-inch cylindrical enclosure, 10 feet above the ground. Every one millimeter of rainfall captured by the 12-inch funnel tips the bucket and sends a signal to an ALERT transmitter located within the base of the 12-inch cylinder. Stream level can be measured with a variety of instrument types both analog and digital. Stream level data is sent to the ALERT transmitter either at a predefined time interval or at a change in stream stage. Stream level and rainfall sensors are often combined in a single station location. Most stations are battery operated and many have solar panels attached to maintain battery voltage. These stations are designed with fairly low power requirements to facilitate remote installations. Each sensor at a station has a unique 4 digit ID number issued by the National Weather Service. Every transmission contains this ID number with the sensor data.

This data is summarized at the base station in both text and graphic formats. These summaries give critically important information on the flood threat as it develops. The data can also be used to provide input for a

forecasting model to provide the manager with a view of a number of different storm scenarios. Management of the crisis becomes more standardized because important decisions on evacuation can be predicated on specific real time rainfall and stream level information.

Distribution of this information to the general public has become widespread with the advent of the Internet, and ***caution*** should be exercised when releasing unverified gauge information on the Net. Unverified gauge data could complicate public response to your warnings. It is most important that the public focus on your warnings, with the gauge information provided as supplemental support only, not as the public's primary focus.

Another problem can be coordination with other agencies. Disparity between your warnings and those from other sources can lead to serious difficulties in public response to your warnings. Careful coordination, a complete flood response plan, and educating the public about the system and the flood plan, will help avoid these problems.

The cost of implementing and maintaining an ALERT system is fairly small in comparison to the enormous damage a flood can inflict on lives and property. The National Flood Insurance Program's Community Rating System program recognizes the merit of a flood warning system - credit toward reducing flood plain insurance premiums is allotted for operating a system.

A thoughtfully designed and maintained system is a valuable asset in the complex management of a community's floodplain.

This article only briefly summarizes the implementation and operation of an ALERT flood warning system. Since the initial ALERT installation in 1977 in Monterey County, there have been tremendous advances in computer hardware, software, communication, and remote instrumentation; this makes the task of keeping abreast of the latest developments difficult. Fortunately some excellent guidance on the planning and implementation of an ALERT flood warning system is available.

The National Weather Service in 1977 published the *Automated Local Flood Warning Systems Handbook*. This handbook is an excellent resource for both managers contemplating an ALERT System and those who already have a system in place.

Another resource is an organization of managers and operators of existing ALERT systems: The ALERT Users Group, formed nearly 20 years ago, includes ALERT systems managers and operators, National Weather Service personnel, and vendors supplying ALERT services and products. This group meets regularly in small group meetings, and every other year at a multi-day conference. Their website address is at www.alertsystems.org. This site also contains information about other groups around the country. This year the ALERT Users Group will be holding a three-day conference on May 7 - 10 in Santa Barbara, California.

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For further information contact Rob Nelson at rnelson@roseville.ca.us, (916) 774-5794.

Public Comment on AB 1147 to be Sought Soon

Proposed regulations for AB1147 (99-00), Financial Assistance for Flood Management Projects and Small Flood Management Projects, will be coming out soon for public comment.

To be notified of the upcoming rule-making or for more information contact

Karina Dahl
kdahl@water.ca.gov
(916) 653-8492, or
Susan Lee
susanl@water.ca.gov
(916) 651- 7108.

Multiple Benefits of Floodplains in Flood Protection Projects

by Steve Yaeger

The lessons learned from the 1993 Mississippi River floods and the 1986, 1997, and 1998 floods in California are giving flood protection professionals a different view of how we ought to formulate projects. We have learned that to rely solely on structural solutions to flood protection does not account for the residual risk related to structural solutions. (This risk is often enhanced by the type of solution selected.) We have learned that we need to incorporate the multiple uses of the floodplains in our planning for flood protection. Most importantly, we need to recognize the value that society places on the other benefits that floodplains afford - to integrate the protection and enhancement of these resources in our planning efforts so that the communities pursuing the economic benefits of flood protection can also enjoy the economic and esoteric benefits of the full spectrum of benefits floodplains provide.

Current planning efforts to protect "national treasures" such as the Everglades in Florida and the Sacramento and San Joaquin Rivers and the Sacramento/San Joaquin Rivers Bay-Delta in California make it clear that society desires and insists that we formulate programs which protect and enhance natural resources while providing more traditional benefits such as water supply and flood protection.

Projects that provide sustainable protection for floodplains while protecting urban and rural communities from floodwaters are ideally suited for a multi-objective approach that incorporates protection and enhancement of other natural resources. These include floodplain habitat, wetlands, open space, sustainable agriculture, water quality, riparian habitat, and many other resources. By applying a multi-objective approach to the use of the floodplain, planners are finding that they can develop programs that provide immediate flood protection and that also protect and enhance the multiple benefits that floodplains exhibit naturally. These programs can be flexible enough to change and evolve and react to floods that are larger than the design flood, changes in hydrology, regional and global climate change, changes in population growth patterns, changes in land use, and changes in the relative values that society places on natural resources.

These multi-objective floodplain enhancement projects not only enjoy a broader base of public support but also enjoy the many benefits that floodplains can provide. This approach forms a solid basis for developing solutions to many of the resource management challenges we face today. Better water quality, more sustainable environmental resources, enhanced habitats for fish and wildlife (whether endangered, listed, or not), management of sediment loads, providing open space and recreational opportunities, sustaining agriculture, and many other benefits of floodplains are riverine corridor resources which the public both values and desires. Because flood protection projects are directly connected to the river and stream system and their floodplains, incorporation of planning for the full spectrum of resources in flood protection projects planning is the best vehicle for achieving protection and enhancement of these other important resources and ensuring that we achieve a comprehensive, integrated and sustainable flood protection system.

Why does it make sense to pursue a multi-objective planning approach instead of the tried and true single-objective flood protection project planning effort? The rapid development and population expansion in our State in the last half century – the pace

of which is increasing and will continue to increase in the future – drives a competition for the considerable but finite resources of the State. The need for public safety, i.e. sufficient flood protection, historically has competed with needs to protect and enhance water quality, needs to protect and enhance habitats for fish and wildlife, needs for public open space, for opportunities for public recreation, and with needs for other valuable natural resources. To pursue a course of planning projects for a single objective – flood protection, however important and laudable public safety is, places flood protection in the role of potentially compromising and jeopardizing the other important resources that the floodplains provide. However, this competition is not necessary, and in fact, can be converted to a synergistic project approach through multi-objective planning. While promoting the good stewardship of our resources, multi-objective projects can also represent the best investment of the public dollars that support public safety projects.

How best can we advance multi-objective planning for the floodplain? Encouraging successes have been achieved by adopting a broad watershed approach for the foundation planning efforts. For example, planning efforts for the Sacramento and San Joaquin River Basins and the Bay-Delta of California[1] have adopted this multi-objective approach. The natural resources within the watershed were catalogued and the problems that these resources were experiencing inventoried, analyzed, and an understanding of the resource interactions developed. Strategies were developed to address all of these resource problems so that all resources are advanced evenly and that any compromise of one resource with respect to another resource is mitigated. To achieve this, the various academic and professional disciplines were called upon to address the full spectrum of resource management issues. Results of the actions that are implemented are monitored and future actions are adjusted to account for the identified impacts. Methods were developed to analyze and display the true economics of protecting and enhancing the full spectrum of natural resources, including floodplain benefits. The expertise and energy of stakeholder interest groups and the general public was mobilized as an important resource to the planning and implementation effort. Processes were developed which take advantage of the contributions which public sector groups can make to these efforts and actions taken to pair the public sector groups with private sector resources.

While the jury is still out on the success of the implementation of these broad watershed based planning efforts, it is clear that the multi-objective planning processes employed by these programs lead to a more technically credible, more economically justifiable, more sustainable, more adaptable approach to water resource issues – especially public safety issues - and lead to better stewardship of the multiple benefits which our floodplains provide naturally.

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Footnote 1-Projects referred to include the Comprehensive Study of the Sacramento and San Joaquin River Basins, a joint planning effort of the Corps of Engineers and the Reclamation Board of the State of California, and the CALFED Bay-Delta planning project.

For questions or further information about this article, please contact Mr. Yaeger by e-mail: <syaeger@water.ca.gov>.

Early Notice

The first public meeting of the **California Floodplain Management Task Force** will convene on April 18 and 19, 2002 in Sacramento.

Further information is available at www.fpmtaskforce.water.ca.gov, or email at <taskforce@water.ca.gov>.

The Future of Floodplain Management

by Peter Rabbon

In California, floodplain management's responsibility is shared among three levels of government, local, State and federal. The Reclamation Board became involved in floodplain management when it was established in 1911 to address flooding in the great Central Valley. The Sacramento River Flood Control Project was authorized in 1916 and in 1944, projects were authorized for the San Joaquin River. These and many other projects were authorized in response to the needs and desires of society at the time. The Reclamation Board has continued to partner with locals and the Corps of Engineers in developing projects for the Central Valley that reduce flood damage. These projects, in general, are structural projects, such as the building of levees or dams, and are intended to correct existing flood management problems**.**

In the late 60's, the federal government and the State Reclamation Board began to recognize the need to prevent future flood management problems from being created so that corrective action (levees and dams) would not be required. The federal government instituted the National Flood Insurance Program, whereas the Reclamation Board instituted the designated floodway program. The two are similar in that they are both nonstructural programs intended to prevent future flood management problems.

Is this enough? Do our corrective programs and preventive programs solve California's flood management problem; or are our current corrective and preventive programs simply triage for a problem that is continuing to grow as California's population continues to grow? I believe we should reevaluate our flood management perspective. A preventive program should be developed that works *so well* it prevents all future flood managment problems from occurring - eventually eliminating the corrective program.

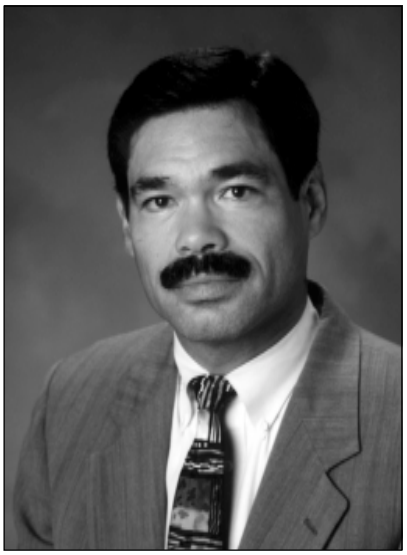
How could one create a program so successful it would ultimately put many of us out of a job because of the lack of flood management problems that would require our attention? Let's consider the following scenario for a new flood management policy. First, assume quality floodplain maps identifying high levels of protection (greater than 500 year level of protection) are available to local land use decision makers throughout California; next take a *snapshot* of California to identify all existing buildings, infrastructure, and damageable properties within or near the floodplains; then on the specified date that the snapshot was taken new rules are promulgated: (a) local, State, and federal funding to correct flood managment problems will be available only for facilities shown on the snapshot, (b) the National Flood Insurance Program will be available only for structures shown on the snapshot; (c) all structures in the snapshot remain eligible for flood management programs such as flood fighting and rehabilitation, (d) for all **future** buildings, infrastructure, and damageable properties constructed after the snapshot, no local, State, or federal programs and/or funding will be provided for flood management purposes. If the owner elects to be part of a corrective flood management project or receives benefits from other flood management programs, all costs apportioned to that parcel shall be payable directly by the property owner. In other words, the new flood management program is a *no* flood management program.

What would happen? Turmoil and chaos would exist during the first flood events and financial hardship would be created for those properties that were constructed after the snapshot date as owners attempt to rebuild in floodplains. However, under the above scenario, this type of disaster would help urge land use decision makers (forced by economics) to build up or out of the floodplain. These land use decisions would thereby ensure that additional flood management problems would not be created for future generations to correct. Eventually, the floodplain management program in California could primarily exist only to maintain those flood management systems that are currently in place -- and over time you and I would be out of a job and California would be a better place to live.

Mr. Rabbon may be reached by email at <prabbon@water.ca.gov>

Faces in FPM:

Pete Rabbon became General Manager for the California Reclamation Board in 1997. The Reclamation Board is a seven-



member, Governor-appointed board with jurisdiction for flood control activities in the Central Valley. Although administratively located within the California Department of Water Resources, the Board is a separate legal entity that works closely with the Department and its Division of Flood Management.

Pete started his career as a geotechnical engineer, involved in planning, field inspection and investigations, laboratory analysis, and design. He also worked for Sacramento County in construction management prior to joining DWR. Pete's varied career in state service with DWR includes working as an engineer in both the field and design branches of the Division of Safety of Dams and managing planning efforts for the Sacramento and San Joaquin Delta Levees Program in the Department's Planning Branch. In 1988 Pete was involved with the Division of Flood Management as Chief of the Flood Operations Branch, where he was responsible for overseeing local and State operations, and maintenance of flood control facilities and the State's flood fight emergency response. As Chief of the Flood Control Project Branch, he was responsible for developing and implementing federally authorized flood control projects for the Central Valley and providing staff to The Reclamation Board. Prior to becoming the Board's General Manager, Pete left flood management activities for a year to become Project Engineer for completing construction of the $500 million Coastal Branch Phase 2 Project of the State Water Project.

Pete also has worked as a manager for the Department of Fish and Game; was a principal in a developer/builder partnership; and performed research. He holds a Bachelor of Science and a Master of Science in Civil Engineering from the University of California, Davis; he is a registered engineer in California, Nevada, and Oregon, and is a licensed California contractor.

Editor's comment: Pete ended his biographic information with the fact that he was *born, raised,* and currently *lives* in a floodplain. *So, welcome to Pete Rabbon - a floodplain man from first to last!*

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After spending seventeen years in water resource engineering in private sector consulting, local government, and with special districts with an emphasis in planning for water supply and flood management projects, **Steve Yaeger** joined the CA Department

of Water Resources fifteen years ago in the Operations and Maintenance Division, working in the supply and operations forecasting section. Moving shortly thereafter to the Division of Planning, Steve worked in the State Water Project Planning Branch leading the feasibility study team on the Los Banos Grandes Offstream Reservoir Project and producing the environmental documentation and feasibility study for that project.

After completing that project, Steve moved over to a project management position in the Executive Division, working with the Divisions of Flood Management and Planning as project manager for the American River Watershed Investigation of water supply and flood management. He was responsible for managing the congressional authorization initiative of that project in the early 1990's.

After being named as Deputy Executive Officer of the Bay-Delta Oversight Committee in late 1991 – a State lead stakeholder initiative to address the environmental, water quality, levee instability, and water supply deficiencies in the Sacramento and San Joaquin River Delta – Steve provided technical oversight to programs to address the multi-objective initiative of the Resource Agency and the Department of Water Resources to solve the Delta problems.

When the federal government joined the State in the Delta initiative, resulting in the CALFED program for addressing the Bay-Delta problems, Steve continued as the Deputy Director of CALFED for four years, directing the technical programs that led to the EIS/EIR and the CALFED Record of Decision for the Delta solution.

The Comprehensive Flood Management Study of the Sacramento and San Joaquin River Basins was the next assignment which Steve accepted in 1998, serving as State Study Manager. While completing that study of alternatives for enhancing flood protection and recovering environmental values of the riverine environment of the Sacramento and San Joaquin Rivers, Steve also assumed his present position as Chief of the Floodplain Planning and Management Office of DWR's Division of Flood Management. In this position he oversees the Floodplain Management Branch (responsible for this publication, statewide floodplain mapping, permitting of proposed encroachments in the flood control projects and designated floodways, and other statewide floodplain management programs and overseeing local floodplain management activities); the Floodplain Planning Branch (responsible for Central Valley floodplain planning projects such as the Comprehensive Study of the Sacramento and San Joaquin River Basins and the American River Basin); and the Environmental Planning Branch of the Division of Flood Management (responsible for the planning for the incorporation of natural floodplain processes into flood management projects and environmental planning and review of DFM projects and outside flood management and project encroachment projects).

The biggest challenge in this latest position, according to Steve, has been integrating the flood management activities of the Department with programs to enhance the natural floodplain benefits associated with the State's remaining natural environments.

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Editor comment: We started the "New Faces" feature to introduce to you new employees you might be dealing with by mail or phone on floodplain management issues. We recently decided that you might also appreciate an introduction to those in related positions, not just those with FPM assignments. We hope seeing the face with the name and background data is interesting and helpful to you.

Elevation Certificates

For information about the Surveyor's Guide to the FEMA Elevation Certificate training module, visit the web site at: **http://nfip.kevric.com/ecsurveyor/.**

HEC Software for FPM Studies

by Gary W. Brunner, P.E., USA Corps of Engineers

The ***Hydrologic Engineering Center*** has been developing software to perform floodplain management studies for over 35 years. The primary goal of HEC software development is to serve the Corps of Engineers' needs in performing water resource studies. At the same time, we endeavor to develop the software so that it may also serve the larger water resources community. Because the software is developed at federal expense, it is available for others to use at no charge. This article summarizes HEC's latest software products for performing floodplain management studies. These products, described below, are for use in the areas of river hydraulics, surface water hydrology, reservoir simulation, and flood damage analysis.

River Hydraulics: Calculating water surface profiles is an essential component of any floodplain management study. The main piece of software developed by HEC in the area of river hydraulics is HEC-RAS (River Analysis System). The HEC-RAS is comprised of a graphical user interface, separate hydraulic analysis components, data storage and management, graphical and tabular output, and reporting facilities. This software can be used to perform water surface profile calculations for both steady and unsteady flow conditions. HEC-RAS is the successor to the steady flow program HEC-2, and the unsteady flow program UNET. Future releases of HEC-RAS will include sediment transport calculations, which will replace the current HEC-6 software.

HEC-RAS can perform one-dimensional hydraulic calculations for simple to complex river and floodplain systems. The steady flow component of the system solves the energy equation, while the unsteady flow component solves the full momentum and continuity equations. HEC-RAS can calculate water surface profiles for subcritical, supercritical or mixed flow regime situations (draw down profiles and hydraulic jumps). The bridge hydraulic routines in HEC-RAS can handle the full range of low flow, pressure flow, weir flow and highly submerged flow over the bridge. The software has the ability to model various types of culverts (circular, box, arch, pipe arch, low profile arch, high profile arch, elliptical, semicircle, and Con Span culverts), as well as combinations of culvert groups and bridge openings. Both inline and lateral weirs and gated spillways (sluice or radial gates) can be modeled. Additionally, off-line storage can be accounted for, as well as the connections from the river to the storage and between storage areas.

Several special types of analysis can be performed with HEC-RAS, including: floodplain encroachment analyses for FEMA floodplain and floodway mapping, channel modifications for flood reduction or environmental enhancement, bridge scour and failure analysis, and split flow optimization. Additionally, HEC-RAS can interact with GIS through the use of a companion product called HEC-GeoRAS. The Geo-RAS software allows the user to extract cross sections and other geometric properties for use in HEC-RAS. Users can also send HEC-RAS results back to GeoRAS for floodplain mapping within the GIS (Geographic Information System). A new version of HEC-RAS (version 3.1) and HEC-GeoRAS will be released early in 2002. New features for this version will include dam and levee breaching, pump stations, navigation dams, floodway encroachments, and mixed flow regime calculations for unsteady flow analyses.

Surface Water Hydrology: Predicting the magnitude, volume, and timing of runoff from precipitation (rainfall and snowmelt) is another essential aspect of many floodplain management studies. The current software developed by HEC to perform surface water runoff calculations is HEC-HMS (Hydrologic Modeling System). HEC-HMS is comprised of a graphic-user interface, integrated hydrologic analysis components, data storage and management capabilities, and graphics and reporting facilities. This software supersedes the HEC-1 package, which was our previous hydrologic modeling program.

The HEC-HMS software provides a variety of options for simulating precipitation-runoff processes. The software offers several infiltration methods - Green and Ampt, Deficit Constant, SCS, gridded SCS, Soil Moisture Accounting, and Initial and Constant, as well as base flow and recession options. Traditional unit hydrograph (Clark, Snyder, SCS, and user specified) and kinematic wave overland flow routing are available for transforming rainfall excess to runoff. For routing and combining hydrographs, there are several hydrologic routing techniques available, including: Modified Puls, Muskingum, Muskingum-Cunge, Kinematic Wave, and a Lag method.

The HEC-HMS software also has the ability to perform quasi-distributed runoff calculations on a gridded basis, using what is called the Mod-Clark method. This method utilizes gridded precipitation from either rainfall radar or a gaged network. Additionally, a detailed soil moisture accounting algorithm is available for performing continuous (i.e. long period) simulations. The software also has options for adding in flow from an exterior source, losing flow in what is called a sink, diverting water and routing hydrographs through uncontrolled reservoirs. HEC-HMS can also interact with GIS through the use of a companion product called HEC-GeoHMS. The GeoHMS software automates the process of defining watersheds and sub-watersheds, calculating areas, stream lengths, land slopes, and several other parameters. This information can be directly imported into HEC-HMS.

HEC-HMS Version 2.2.0 is currently in beta testing and will be released for general use this Spring. The emphasis in the new version is on the simulation capabilities of the reservoir element. The new version has the added ability to simulate storage and outflow using Brent's iterative solution technique. In this paradigm the user enters an elevation-storage or elevation-area curve along with the physical characteristics of structures that release water from the reservoir. Options include an orifice outlet, broad-crested spillway, ogee spillway, level dam overflow, nonlevel dam overflow, and dam breach. Work on the reservoir will continue in the future with the addition of more outlet structures and control capabilities necessary for simulating interior flooding mitigation projects.

Reservoir Simulation: Floodplain studies of large watersheds may involve the analysis of one or more reservoirs operating as a system for multiple purposes (i.e. water supply, flood storage, water quality,s and low flow augmentation). The HEC has developed a new reservoir simulation program called HEC-ResSim, which is the successor to the current HEC-5 reservoir model. HEC-ResSim has a graphic- user interface, computational program to simulate reservoir operations, data storage and management, and graphics and reporting facilities.

The HEC-ResSim model can be used to analyze a single reservoir or a system of reservoirs. The user enters physical data about the reservoir - storage pool information, the dam and outlet works descriptions - as well as operations data and release rules. Rules can be developed to control individual outlets or a group of outlets for a particular reservoir. The control of the outlets can be based on what is happening at that specific reservoir, or it can be based on downstream goals and constraints. When multiple reservoirs are operated for the same downstream control point, the software will negotiate the releases from all of the reservoirs based on storage balancing objectives. HEC-ResSim is a completely new software package. The first public release of this software is scheduled for Spring, 2002.

Flood Damage Analysis: The HEC has developed several pieces of software for computing flood damage. The current software package is called HEC-FDA (Flood Damage Analysis). This software package allows the user to compute expected annual damage for existing conditions, as well as any proposed flood damage reduction alternatives. The FDA program also has the ability to incorporate uncertainty into the evaluation of alternatives and includes methods for defining flood risk and project performance.

HEC-FDA operates in several modes, including Study Configuration, Data assembly, Hydrologic Engineering, Threatened Properties, Plan Formulation, and Analysis. Study Configuration allows the user to specify global information about the study. Data Assembly imports and constructs spatially referenced maps and coverages, including stream alignments, aerial photographs, and digital terrain data. Hydrologic Engineering al-

lows the user to enter or import water surface profiles, exceedance probability functions, rating curves, and spatially referenced flood inundation and depth layers, which are computed outside of the FDA software - normally with HEC-HMS and HEC-RAS. Under Threatened Properties, potential damage is developed for damage areas from traditional structure inventories (property and contents), census track data, or gridded land-use layers. In Plan Formulation mode, plans are formulated and associated life-cycle costs with uncertainty are prepared. Under Analysis, HEC-FDA performs calculations and presents results in tabular, graphic and special display formats. The current version of HEC-FDA (version 1.2) is in the process of being updated to incorporate greater use of GIS technology in both extracting data and in displaying results.

Current versions of the HEC software and documentation can be downloaded for free from our web site at (www.hec.usace.army.mil). However, HEC does not provide technical support to the general public in the use of this software. There are several venders listed on our web site that provide technical support for a fee. Additionally, specialized training courses are offered both through public and private entities on the use of this software.

For clarification about this article, only, e-mail to "gary.w.brunner@usace.army.mil". For further information about the HEC or its products, visit the website at (www.hec.usace.army.mil).

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Historic Purchase Increases Yolo Bypass Wildlife Area

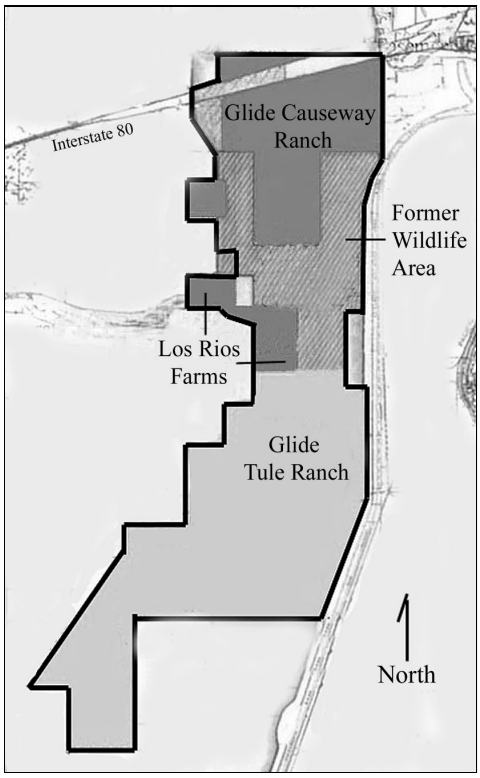
by Dave Feliz & Robin Kulakow

Editor comment: The Yolo Bypass is a leveed flood control bypass of the Sacramento River flood Control Project, about 5 miles west of Sacramento. During non-flood periods the Bypass is dry, but during major flood events it may convey up to 500,000cfs. The Bypass provides land for a variety of farming uses. riparian and managed wetland habitats, and habitat for water fowl.

The acquisition of 12,808 acres to be added to the Department of Fish and Game Yolo Bypass Wildlife Area was completed on December 14, 2001 with the close of escrow on the purchase from the Glide Trust and Los Rios Farms. The Nature Conservancy worked tirelessly to facilitate this transaction which will add thousands of acres of historic wetlands, creek-side forest, and grasslands for waterfowl, shorebirds, and many other important associated species. The $16.6 million purchase was funded by a grant from the State Wildlife Conservation Board.

The most ambitious dreams of Yolo Basin supporters could not top this recently completed land acquisition. The addition of the Glide lands and the Los Rios parcels increases the Yolo Wildlife Area to an astounding 16,000 acres. These lands represent the heart of the Yolo Basin including the mouth of Putah Creek and many of the Putah Sinks.

When the Glide and Los Rios properties in the Bypass were put on the market, an unexpected opportunity for public ownership presented itself. Chris Unkel with California Nature Conservancy worked tirelessly to secure an option on the properties and then to negotiate a sale agreement. Fortunately, the CA Department of Fish and Game had previously identified these properties for potential Yolo Wildlife Area expan-



Map of Yolo Baypass Wildlife Area showing original area with recent acquisition.

sion. The Wildlife Conservation Board was able to round up the necessary funding to make the purchase. This set of fortuitous circumstances means that Yolo County communities will have a new public resource beyond anything previously imagined. The addition of the majority of the Putah Creek Sinks is a fitting next step in the recovery of Putah Creek after the Putah Creek Accord was signed in May 2000 regarding permanent flows for the Creek.

It is hard to express what the expansion means for local communities. The addition of thousands of acres of rangeland, wetlands, and riparian forest opens up tremendous opportunities for outdoor education and recreation. Included in the acquisition is the future site of the Pacific Flyway Center. We can expect expansion of the auto tour route, increased hunting areas, wooded trails along Putah Creek, and hundreds of acres of native prairie with spectacular wildflower blooms. Agricultural practices such as grazing and grain production will be used as tools to forge a balanced wildlife habitat program. With the addition of 3 miles of land fronting Interstate 80, it will become very obvious where the wildlife area is. Frequently touted as the highlight of their commute, the view from the Causeway will develop into an even more spectacular wildlife vista.

The Yolo Bypass will continue to be used for flood control and indeed this remains the primary purpose of the Bypass. The fact that we as a people have recognized the potential of using the floodplain of the Sacramento River system for habitat restoration is commendable and allows us to pursue habitat goals on a landscape scale.

Much of the land purchased was acquired by the Glide Family through the Swamp Land Act. The State gave away the land in return for the land owner proving they had reclaimed the wetlands and converted it into productive agricultural land. Today we recognize the importance of wetlands and are buying it back.

Fish and Game will manage already established habitat and maintain existing agricultural leases until a management plan is completed. The management plan will be developed with public input. The Yolo Basin Foundation recently made a successful proposal to the CALFED Bay Delta Program for funding to assist in creating the new Management Plan. The Yolo Bypass Working Group will be one of the venues for public discussion. The new lands will become part of the Yolo Basin Foundation's Discover the Flyway school program. Tremendous opportunity exists for expanding other educational activities.

While it may take a number of years for the State to fund the personnel needed to open up the area to the public, this is a resource that will be enjoyed for years to come. Someday it will be one of the significant features that enhances eastern Yolo County as well as the entire region. In the future the Wildlife Area will come to define the childhood outdoor experiences of legions of adults, much as adults today refer to the open fields of their youth. There will be quiet places, places for adventure, and places to forget the stresses of modern life. It will be a place to wander and imagine what California once was.

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Robin Kulakow, Executive Director, Yolo Basin Foundation (PO Box 9443, Davis, CA 95647) and Dave Feliz originally published this article as part of 2 articles in the Foundation's newletter.

The Golden State Floodlight
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The purpose of this newsletter is to assist local communities in managing their floodplains and in meeting the Federal Emergency Management Agency requirements under the National Flood Insurance Program. This *free* publication is supported under a cooperative agreement with FEMA.

Readers are encouraged to submit reports or draft articles about their experiences with the administration and management of floodplains, the effects or prevention of floods, flooding and cleanup, public education or outreach efforts, or in related fields such as wetlands, storm water management, etc. Relevant photos, black & white or color, are especially welcome. Text or photos will *not* be returned unless specifically requested. Address material for publication to:

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